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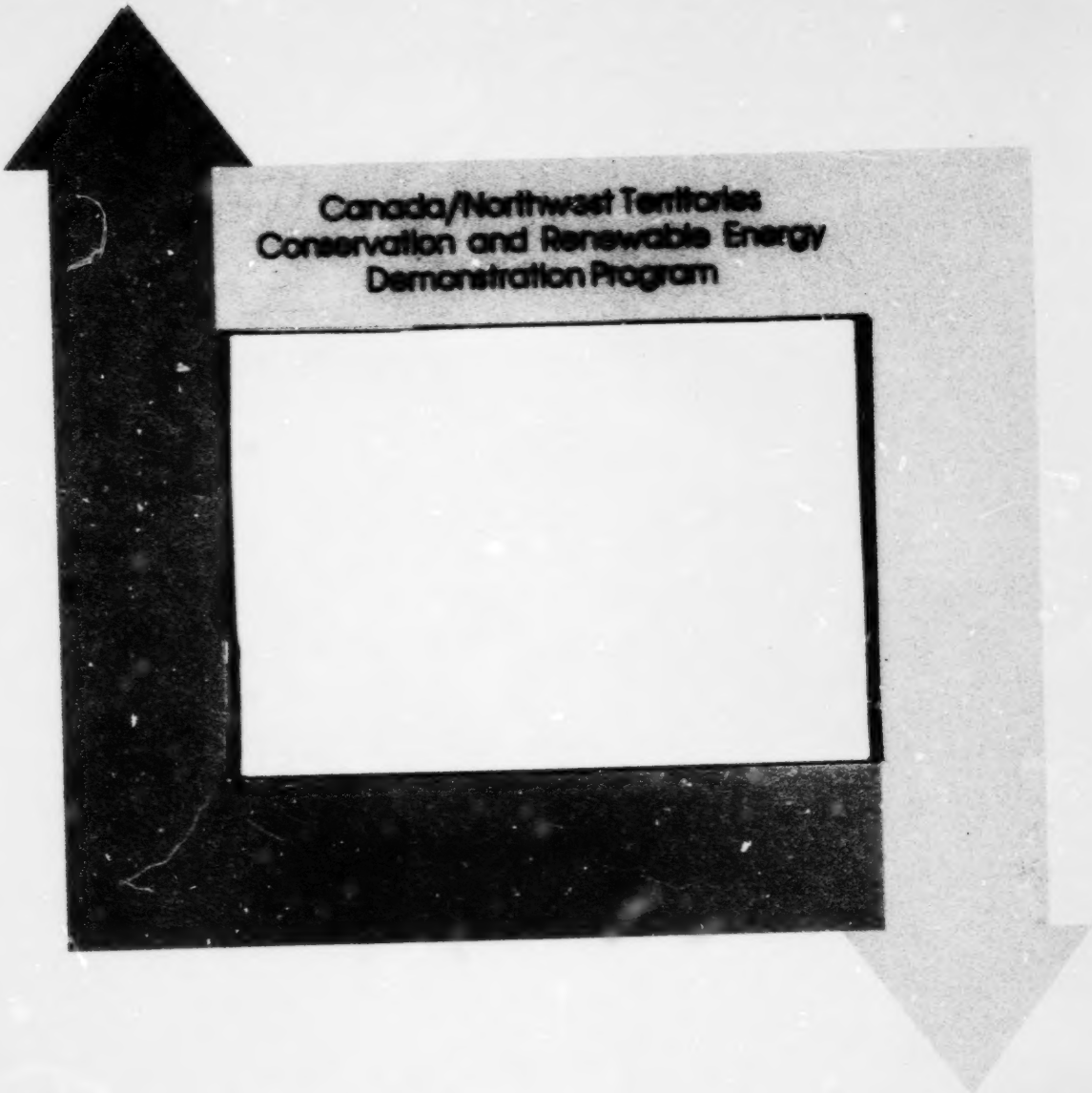

Energy, Mines and Resources Canada

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Northwest Territories Public Works

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ENERGY
CONSERVATION

HAY RIVER
HIGH PRESSURE
SODIUM
STREET LIGHTING

Prepared By

MANECON PARTNERSHIP

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HAY RIVER
HIGH PRESSURE SODIUM
STREET LIGHTING

Report Prepared For

ENERGY CONSERVATION DIVISION
Department of Public Works
Government of the N.W.T.

By

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March 1984

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NORTHWEST TERRITORIES/CANADA CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

The availability of secure and affordable energy supplies is a subject of national concern. It is an accepted fact that our primary energy sources - oil and natural gas - are becoming less accessible and more costly. However, Canada is well endowed with renewable and alternative resources that can provide a bridge into the future.

To this end, the governments of N.W.T. and Canada have entered into a Conservation and Renewable Energy Demonstration Agreement which was signed March 24, 1980 and terminates March 31, 1984. The Agreement is dedicated to the development and demonstration of conservation and renewable energy technologies. Cost-shared by the territorial and federal governments, the program has a total budget of $3.3 million.

The objectives of CREDA are:

- To develop and demonstrate promising new technologies, which, when widely adopted, will exploit renewable resources, conserve energy and/or use energy more efficiently.
- To develop broad public awareness of the potential of renewable energy and conservation technology.
- To provide opportunities for the commercial application of the technologies.
- To create economic spin-off benefits for manufacturing, industry and commerce.
- To create employment in new or existing energy-related industries.

DISCLAIMER

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ABSTRACT

The Town of Hay River N.W.T. converted 420 existing mercury vapour streetlights to use high pressure sodium lamps. 400 watt mercury vapour fixtures were converted to 150 watt high pressure sodium fixtures; 250 watt mercury vapour fixtures to 100 watt high pressure sodium fixtures.

The work was performed by the franchised utility company for the community, Northlands Utilities (N.W.T.) Ltd., a subsidiary of Alberta Power Ltd. The existing fixtures or luminaires were converted by replacing the ballast assemblies in fixtures from eight different manufacturers with ballast assemblies made by a single manufacturer, GTE Sylvania. The ballast assemblies were installed using two designs of mounting plate successfully developed by Northlands Utilities for the Hay River Project. The costs of the "retro-fit" conversion program were less than that projected necessary to replace whole luminaires with new units, factory fitted with high pressure sodium equipment. In 1984, the town will save $45,224 per year (34%) in energy billings (from a prior cost of $130,586 per year) due to an investment of $66,817.

APERÇU

La ville de Hay River, Territoires du Nord-Ouest, a transformé 420 lampadaires à la vapeur de mercure pour l'usage de lampes à haute pression au sodium. Les appareils à la vapeur de mercure de 400 watts furent convertis en lampes à haute pression au sodium de 150 watts; les appareils à la vapeur de mercure de 250 watts furent convertis en lampes à haute pression au sodium de 100 watts.

Le travail fut exécuté par la compagnie concessionnaire des services publics, Northland Utilities (N.W.T.) Ltd. (Les Services Publics Northland (T.N.O. Ltée.) une filiale de Alberta Power Ltd. (Energie Alberta Ltée.). Les appareils ou luminaires existants ont été transformés en remplaçant les montages de ballast, constitués de plusieurs accessoires venant de huit fabricants différents, par des montages de ballast fabriqués par un seul manufacturier, GTE Sylvania. Les montages de ballast furent installés en utilisant deux modèles de plaque d'assemblage développés avec succès par Northland Utilities (Les Services Publics Northland) pour le projet de la ville de Hay River. Le coût du programme de conversion a été moin élevé que le coût projeté du remplacement des luminaires par des dispositifs entièrement nouveaux, ajustés à l'usine par de l'équipement pour haute pression au sodium. En 1984, la ville économisera $45,224 par année (34%) en coûts d'énergie (d'un coût original de $130,586 par année) suite à un investissement de $66,817.

EXECUTIVE SUMMARY

The Town of Hay River, Northwest Territories replaced a majority of street lamps in the community with energy efficient high pressure sodium lamps. The replacement was accomplished by two methods:

a. substituting new luminaires with factory equipped high pressure sodium lamps and ballast assemblies, for 59 existing mercury vapour lamp equipped luminaires;

b. by retro-fitting new ballast assemblies and lamps from a single ballast supplier, GTE Sylvania, into 361 existing luminaires, previously equipped with mercury vapour lamps.

The retro-fit type conversion is a novel method to accomplish the upgrading of streetlighting to the more efficient high pressure sodium lamp equipment. Generally conversions are performed by installing completely new fixtures on existing light standards. The conversions were completed in the fall of 1983 by the franchised utility company serving the community, Northlands Utilities (NWT) Ltd.

Two sizes of lamps were converted. 400 watt mercury vapour lamps were replaced by 150 watt high pressure sodium lamps; 250 watt mercury vapour lamps by 100 watt high pressure sodium lamps. For each size of luminaire, an adapter plate was developed to physically mount the new ballast assembly from the single supplier to the variety of mounting hole patterns found in the luminaires, purchased over the years from a number of different manufacturers. The two adapter plates developed are a key innovation spawned by this project.

The conversions were performed by first installing the newly purchased luminaires; then retrofitting the recovered luminaires on the bench with new ballast assemblies, bulbs and adapter plates; then swapping retrofitted luminaires with old mercury vapour fitted units on a single visit to the light standard. The conversion was thus performed by batched activities of benchwork and field swaps.

The conversion program successfully demonstrated that retro-fit conversions can be performed using one ballast in many styles of luminaire, and verified that the retro-fit conversion method is cheaper than replacing the whole fixture with a new factory equipped fixture.

The Town expects to, and will, save $45,224 in energy billings per year, realizing a simple payback on capital invested in 17.8 months.

This report documents the work performed as part of the conversion project, the problems encountered and experiences gained, and presents an economic analysis of the project. The commercial market potential of the retro-fit conversion "kit" is discussed and a marketing strategy for its commercialization is presented.

EXPOSE SOMMAIRE

La ville de Hay River, Territoires du Nord-Ouest, a remplacé la majorité de ses lampadaires par des réverbères à haute pression au sodium et à bon rendement énergétique. Le changement fut effectué de deux manières:

A) en substituant des nouveaux luminaires avec des lampes à haute pression au sodium et des montages de ballast ajustés en usine, à 59 lumières à la vapeur de mercure.

B) en ajustant des nouveaux dispositifs de ballast et de lampes provenant d'un seul fournisseur, GTE Sylvania, à l'intérieur de 361 lampadaires existants, équipés antérieurement avec des lampes à la vapeur de mercure.

La conversion de type rétro-fit est une méthode originale pour accomplir l'amélioration de l'éclairage des rues, par l'installation de lampes à haute pression au sodium, plus efficaces. D'habitude, les transformations sont effectuées par l'installation de dispositifs entièrement nouveaux sur les pylônes d'éclairage existants. Les changements furent complétés dès l'automne de 1983 par la compagnie concessionnaire des services publics desservant la communauté, Northland Utilities (N.W.T.) Ltd. (Les Services Publics Northland (T.N.O.) Ltée.).

Il y a eu transformation de deux types de luminaires. Les appareils à la vapeur de mercure de 400 watts furent remplacés par des luminaires à haute pression au sodium de 150 watts; les appareils à la vapeur de mercure de 250 watts furent remplacés par des luminaires à haute pression au sodium de 100 watts. Pour chaque dimension de lampes, une plaque de raccord fut développée pour adapter le nouveau système de ballast venant d'un seul manufacturier, aux différentes combinaisons de perforations localisées dans les luminaires, acquis au fil des années d'un nombre de fabricants différents. Les deux plaques de raccord produites représentent une importante innovation engendrée par ce projet.

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Les transformations furent effectuees, en premier lieu, par l'installation des luminaires nouvellement acquis; ensuite, en ajustant en atelier les nouveaux systemes de ballast, ampoules et plaques de raccord, aux luminaires recuperes; enfin, en installant les luminaires transformes a la place des anciens appareils a la vapeur de mercure, par une simple visite au lampadaire. La conversion fut accomplie par dex travaux en atelier, suivis par des substitutions effectuees sur les lieux.

Le programme de conversion a demontre avec succes que des conversions de type retro-fit peuvent etre effectuees en employant un ballast dans plusieurs types de luminaires, et a confirme que se servir de cette methode de conversion est plus economique que de remplacer le dispositif entier avec un nouvel appareil monte en usine.

La ville s'attend, et de fait, y arrivera, a economiser $45,224 par annee sur les couts de l'energie, realisant de cette facon le recouvrement du capital investi en 17.8 mois.

Ce rapport documente le travail execute a l'interieur de ce programme de conversion, les problemes rencontres et les experiences acquises, et presente une analyse economique du projet. Le potentiel commercial d'une trousse de "conversion retro-fit" y est discutee et une strategie d'etude de marche pour sa commercialisation y est presentee.

1.0 INTRODUCTION

Energy costs represent a large fraction of the total operating budget of the Town of Hay River, Northwest Territories. Opportunities for energy conservation are welcomed by the administration. Energy charges for municipal street lighting are a significant portion of the Town's energy budget.

The street lights in Hay River are owned, maintained and supplied with electrical energy by the franchised utility company for the community, Northlands Utilities (N.W.T.) Limited. Northlands Utilities is wholly owned by Alberta Power Limited, a major privately owned utility firm serving Alberta. APL is owned by Canadian Utilities Limited. Northlands Utilities operates diesel electric generation facilities in Hay River with an installed capacity of approximately 8740 kw. Typical energy use by the community totals 23.6 gigawatt hours per annum. The Town of Hay River is billed a fixed charge per month for the supply of street lights and street light electrical energy.

In 1982 the Town of Hay River was approached by Northlands Utilities to consider the replacement of existing mercury vapour street lamps with more efficient high pressure sodium lighting. The motive of the Utility was to offer their client an opportunity for cost savings on one hand, but also to forestall the need by the Utility to increase electrical generating capacity to meet expanding requirements. The resulting analysis, and street light conversion program is the subject of this report.

Two approaches were considered to do the conversion; one was to replace the whole luminaire on each lamp standard with a new luminaire fitted with a HP sodium bulb and ballast assembly; a second approach was to retrofit the existing luminaires with HP sodium ballast assemblies and a new HP sodium bulb. The second approach was favored due to the promise of capital cost savings over total luminaire replacement and to demonstrate the retrofit technique - a means of street light conversion not apparently attempted in Canada before. The interest and support of the CREDA program was secured by virtue of the "retro fit" technique demonstration. A successful technical demonstration could reasonably lead to accelerated conversion of all mercury vapour street lamps in Canada.

Chapter 2.0 of this report provides a description of the street light conversion program undertaken in Hay River. The experiences and observations of the Town and Northlands Utilities during the conversion are recorded in Chapter 3.0. A summary of the capital and operating costs, savings and benefits due to the street light conversion program are summarized in Chapter 4.0.

The conversion kits developed for replacement in the luminaires made by a variety of manufacturers, represent a new commercial product opportunity. Considerations for the marketing and manufacturing of the new product are assembled in Chapter 5.0.

A significant benefit created by CREDA demonstrations is the knowledge gained from the project. An information transfer plan, to widely disperse the results of this project to those in a position to capitalize on the benefits demonstrated in Hay River, is provided in Chapter 6.0.

The considerations and recommendations derived from the Hay River High Pressure Sodium Street Lighting retrofit conversion activity are summarized in Chapter 7.0.

2.0 STREETLIGHT CONVERSION PROJECT DESCRIPTION

SUMMARY

A total of 420 mercury vapour streetlights were converted to use high pressure sodium lamps. 59 of the streetlights were converted by total substitution of the mercury vapour luminaire assembly for a high pressure sodium luminaire (the luminaire assembly is the complete light head consisting of a cast aluminum frame, glass window, lamp, lamp socket assembly, wiring, lamp ballast assembly), 361 streetlights were converted by replacing the lamp ballast and bulb in existing luminaires with high pressure sodium equipment. The majority of the conversion program was completed in the fall of 1983 by Northlands Utilities maintenance staff, in response to a purchase order from the Town of Hay River authorizing the work.

PROJECT PLANNING

Northlands Utilities approached the Town of Hay River in April, 1982 to consider the changeover of streetlights in Town from mercury vapour to high pressure sodium. Due to the fact that high pressure sodium lamps produce much more light per unit of applied electrical power (100 - 110 lumens/watt) as compared to mercury vapour lamps (40 - 50 lumens/watt), the conversion would provide the same general illumination intensities with a reduced energy consumption. The capital costs of the conversion would have to be borne by the Town of Hay River since no additions to the service or to the number of street lamps were being provided by Northlands Utilities Limited. All operating cost savings resulting from the lower energy consumption, would be passed on to the Town through reduced monthly energy billings.

Analysis of the capital costs involved, by Northlands Utilities, indicated that it would be cheaper to purchase HP sodium ballast assemblies and HP sodium lamps from a luminaire manufacturer and retrofit this equipment into existing luminaires. This alternative was preferred over the purchase of all new luminaires based on careful consideration of

component shipping costs and an efficient labour plan to undertake the conversions.

The retrofit type conversion could be accomplished simply by replacing the light bulb, and by replacing the ballast assembly controlling the bulb operation. The bulb screw socket, reflector and fixture would be the same before and after conversion.

The ballast assembly in a gas discharge lamp (HP sodium or mercury vapour) performs the function of a current regulator and that of a starter or gas arc igniter. Current regulation is accomplished by an inductive coil in series with the lamp consisting of a magnetic ferrite "doughnut" or core with many turns of wire wound through the core. A capacitor is sometimes placed electrically in parallel with the lamp to provide power factor correction (to reduce the electrical reactance of the electrical load). A starting electrode or igniter is provided as the third element of the ballast assembly. The role of the high pressure sodium lamp igniter is to supply a 2.5 - 4.0 kv one micro second duration energy pulse to the lamp to initially ignite the gas in the lamp when the bulb is energized.

During the capital cost analysis, it became apparent that the lamp ballast assembly carrier plates (the inductance coil, igniter, and capacitor are mounted on a simple bracket or carrier plate) were different in the various styles of luminaires around town. Therefore, any single HP sodium ballast assembly purchased to make the conversion would have to be fitted with an adapter plate to interface the assembly to the different mounting posts and hole patterns found in the array of luminaires. Northlands Utilities took up the challenge to inspect every different type of luminaire in service in Hay River (eight different styles or manufacturers were found), map out the mounting posts and hole patterns, and come up with an adapter plate designed to fit a ballast assembly into any luminaire.

A total of 420 mercury vapour street lights were identified for conversion. 316 of the lights were 250W mercury vapour units; 104 were 400W mercury vapour units. Based on the existing light pole heights and

spacings along the street, and the intent to retain similar lighting levels (brightness, and lighting uniformity along the street) using HP sodium, the 400 watt mercury vapour units were to be replaced by 150W HP sodium lamps; 250W mercury vapour units by 100W HP sodium lamps.

Various luminaire manufacturers and ballast assembly manufacturers were contacted to find out if a universal adapter plate or mounting bracket existed to permit the fitting of a manufacturer's ballast into a variety of manufacturers' luminaires. The result was that apparently luminaire manufacturers were only prepared to supply HP sodium ballast assemblies to fit their own luminaires. No firm was interested in fitting their ballast to another firm's luminaire. Northlands Utilities (NUL) selected the 150W HP sodium ballast assemblies, and the 100W HP sodium ballast assemblies from a prominent luminaire manufacturer, Sylvania. NUL technical staff examined the existing lamps in the Town, purchased over the years from a variety of sources including Sylvania, Westinghouse, General Electric, Power Lite, and McGraw-Edison. Two adapter plates (and mounting spacers in some cases) were developed; one to interface the 100W HPS Sylvania ballast to all of the 250W mercury vapour luminaires encountered; the second to interface the 150W HPS Sylvania ballast to 400W mercury vapour luminaires.

The time and costs to develop the plates were absorbed by Northlands Utilities without charge to the Town. The recurring production costs to make the plates ($\simeq$ \$2.50 per unit) were factored into the project budget.

PROJECT EXECUTION

The conversion activity took place in the fall of 1983. During the earlier inspections of the luminaires some units were found to have cracked or broken glass windows or other faults that dictated the total replacement of the luminaire (a replacement glass plus a retrofit ballast, cost more to purchase and install than a whole new luminaire). Consequently 59 new luminaires, and 361 ballast sets were ordered. Adapter plates were manufactured by an Edmonton based metal stamping firm, Custom Tool and Die Co. Ltd.

The first step was to install the new HP sodium luminaires (with factory installed HP sodium ballast and bulb) at locations where existing luminaires were to be retrofitted. The recovered luminaires were retrofitted in the shop with adapter plates, HP sodium ballast assemblies, HP sodium lamps, and were cleaned and tested. These units were placed in the field and another batch recovered for retrofit (or disposal) in the shop. In this manner, all 400W mercury vapour lamp locations were refitted with 150W HP sodium luminiares (the luminaire bodies were formerly on some other pole); and all 250W mercury vapour lamp locations with 100W HP sodium luminaires.

The batch replacement workplan permitted the work crew to approach each lamp standard only once (the present luminaire was immediately replaced with a prior retrofitted unit). The batch workplan minimized running between the shop and field, negated the need to do ballast installation on the pole, and provided "production line" economies on the conversion bench.

The luminaires were replaced in the field by means of a two or three man crew using a truck mounted hydraulic cantilevered lift ("cherry picker") fitted with a safety bucket to carry the workman. The substitution of one luminaire for another could be accomplished in 6 - 8 minutes in some cases, depending on the attachment requirements for a particular brand of luminaire. Northlands Utilities suggest 0.5 manhours per luminaire as an overall budget figure for the luminaire substitution activity.

Conversion of luminaires in the shop was accomplished in 10 - 20 minutes in most cases. An overall budget of 0.4 manhours per luminaire has been suggested for batched retrofit conversion activities on the bench.

A few photographs of the interior of luminaires, fitted with HP sodium ballast, are presented in Appendix B.

Fabrication drawings and notes for the two adapter plates, developed to fit Sylvania ballast assemblies into the existing Hay River luminaires, are presented in Appendix C.

3.0 OBSERVATIONS DURING INSTALLATION AND MONITORING

3.1 INSTALLATION

1. The technique of converting the luminaires on the bench, in batches, was considered to be successful. The fact that a converted luminaire was placed on the lamp standard immediately after a mercury vapour luminaire was removed allowed the completion of the conversion with only one visit to the pole. A single visit conversion was judged to be a very effective means to minimize conversion costs.

2. In portions of the Town, individual lamps are fitted with daylight sensing photocells. In other areas, the power to clusters of lamps was controlled by a single relay. The lamp removal/replacement crew had to make sure that luminaires fitted with photocells (to trigger lamp start-up at dusk) were replaced with converted luminaires also fitted with photocells.

3. The design and use of a single multi luminaire adapter plate was considered reasonably successful by Northlands Utilities. The plates were cheap to manufacture. Each plate (either a 150W plate or a 100W plate) was produced by stamping at a cost of $2.40 - $2.45 each (in quantities of 100 - 300, tooling costs included). In some cases, spacers or stand-offs had to be made up to position the plate at a suitable elevation inside a particular brand of luminaire to accomodate the new ballast. This added slightly to the conversion cost and time. The placement of screws holding down the components of the ballast assembly on their carrier plate, and the drilling (on the bench) of new mounting holes for the factory supplied carrier plate to attach to the adapter plate were not always precisely made. Consequently, some individual modifications to adapter plates were required to mount particular ballast assemblies. Northlands Utilities feel the adapter plate hole patterns are reasonably correct and forgiving, but some refinement could still be made.

4. A supply of new luminaires will likely be installed as part of any conversion project. In cases where the glass window or refractor of the luminaire is cracked or broken, the cost in materials and labour to convert the ballast and change the glass window would exceed the cost of a completely new HP sodium fitted luminaire.

3.2 PERFORMANCE

The performance of the high pressure sodium lamps has been generally satisfactory.

1. Little public response to the conversions has been voiced. One or two comments about the pleasing orange light colour have been passed to the Town. Visibility during blowing snow conditions has been improved according to some perceptions. In fact, the lighting intensities have been reduced very slightly by the addition of the high pressure sodium lamps. This has occurred since 150W or 100W HP sodium lamps provide slightly less light at ground level than do their predecessors, 400W or 250W mercury vapour lamps. The new light intensities still meet Illuminating Engineering Society of North America standards.

2. Illumination patterns at ground level from the HP sodium lamps are frequently different from the mercury vapour counterparts. This is primarily due to the shorter lamp length of the HP sodium bulb compared to a mercury vapour lamp. The position of the bulb socket can be adjusted in most lamps to place the bulb in the centre of the luminaire reflector - causing a generally circular illumination at ground level. Some lamp fixtures are adjusted over the years to create oblong patterns, to better illuminate road centres, illuminate unusual road side obstacles, compensate for non-vertical lamp standards, etc. Since the luminaires have changed positions over the course of the conversions, and the HP sodium bulbs are more likely to be off center in the luminaires, some illumination patterns have had to be adjusted to improve the lighting coverage in certain areas.

The reflectors sockets and fixture bodies are generally identical from a particular manufacturer whether the luminaire was factory fitted for mercury vapour or for HP sodium lamps.

3. Cold weather performance of the HP sodium lamps has not been noticably better than the prior mercury vapour lamps. Handbook engineering data suggest that HP sodium lamps have a better cold weather starting capability than mercury vapour lamps. The Hay River experience is that both lamps start satisfactorily at -40°C.

4. A single negative report concerning the HP sodium lamps is a reported tendency to "cycling" in certain lamps. Mercury vapour lamps have a stable operating voltage over their lifetime. As the lamp ages, the emitted light level gradually decreases. The end of useful life for the lamp is not clearly discernable since no catastrophic failure generally occurs - just a more dim light. High pressure sodium lamps require an increase in operating voltage over their lifetimes (1 volt per 1000 hours of operation). A 110V nominal lamp functioning at 95 volts at beginning of life, may require 120 volts near the end of life and will reach a point where the lamp begins to cycle on and off. This occurs because there is insufficient voltage available to restrike the arc at each 1/2 cycle of the AC waveform. The lamp will then extinguish and cool down causing the internal pressure to drop to a point where available voltage again produces ignition. The lamp voltage increases again to the extinguishing point as the lamp warms up. As the field crews become more familiar with this mode of lamp failure, and some short lifetime lamps are weeded out of the system, the "cycling" failures will be only infrequently spotted by the towns folk. (Since some ballast assemblies operate at higher voltages than others, a HP sodium lamp will apparently function with one ballast and not function with another. Some bulb swapping in the early weeks of troubleshooting the cycling phenomenon produced the erroneous theory that ballast-bulb matching was necessary.)

3.3 GENERAL

1. The impetus to pursue lamp conversion as a means to reduce a town's energy charge is not as strong as one might initially believe. Since the towns do not generally own or operate the streetlighting facilities on their streets, no one on a town's staff is involved in the purchase of lamp fixtures, or the analysis of lamp efficiencies, lighting placements, etc. Consequently, the solution to reducing energy costs by the substitution of more efficient lights (HP sodium lights) is not an obvious one to a town administration. The publicity from a successful conversion such as this one at Hay River, aimed at town administrators, will significantly enhance the popularity of this form of energy conservation.

2. The Town of Hay River has approximately 500 streetlamps. 420 are currently HP sodium. The balance will likely be converted in the next one to two years.

3. Many towns have luminaires in place from a variety of manufacturers. This is due to the fact that the lamps are installed over a period of time and are generally purchased on the basis of the lowest luminaire supply bid without regard for what fixtures are already in place.

4. Most ballast assemblies supplied by luminaire suppliers like Sylvania or Westinghouse are in fact manufactured by a few specialized firms such as "Universal" and "Allanson".

5. A screw socket type streetlight circuit tester is a very valuable trouble shooting aid during the conversion program. (See photograph in Appendix B)

6. At the start of this conversion program, no universal adapter plates were on the market and the luminaire manufacturers were not interested in supplying a plate to fit anything but their HP sodium ballast

into their luminaire. Now Crouse Hinds (who recently purchased the lighting products division from Westinghouse, apparently) have a ballast kit to fit both Westinghouse luminaires and popular Sylvania units. A Winnipeg lighting manufacturer is producing a range of adapter plates to place HP sodium ballast in many different luminaire styles (see Chapter 5.0).

4.0 COSTS AND BENEFITS

4.1 CAPITAL COSTS

The projected capital costs to convert existing street light luminaires in Hay River from mercury vapour to high pressure sodium (HPS) were initially estimated to be $155.03 for 400W (MV) to 150W HPS conversions, and $150.93 for 250W (MV) to 100W HPS conversions. These projected figures were assembled as shown in figure 4.1/1. A number of street light luminaires were not to be retrofitted, but were to be replaced with completely new HPS units. The costs of these replacements were projected to be $203.50 per luminaire. The total capital costs of the project then, based on the actual number street lights upgraded, and the prior estimated costs, was set at $66,817. The unit costs cited above formed the basis for the price agreement between the Town of Hay River and Northlands Utilities for the purchase order to undertake the HPS conversion work.

Actual costs to accomplish the conversion were not systematically kept by Northlands Utilities, as work records included time to gather data on hole drilling requirements for the ballast mounting plates, troubleshoot mismatched lamps and ballast, troubleshoot/evaluate some poor quality replacement luminaires, and other "learning curve" type activities. Northland Utilities indicated that material costs generally were close to the estimates, and on a spot check or work sample basis the labour times to accomplish the conversions were generally shorter than initially projected - sometimes almost half the initial estimate.

Northlands Utilities support the conclusion that the capital costs to change over from mercury vapour lighting to high pressure sodium is less by converting existing luminaires with ballast conversion kits, than by replacing the luminaire completely.

Figure 4.1/1

PROJECTED CAPITAL COSTS TO CONVERT
HAY RIVER STREET LIGHTS
from MERCURY VAPOUR to HIGH PRESSURE SODIUM

ITEM	Convert Existing Luminaires with High Pressure Sodium		Totally Replace Old Luminaires with New High Pressure Sodium		TOTAL
	150W	100W	150W	100W	
o Conversion Kit - ballast, igniter, capacitor - mounting plate - shipping to Hay River	$ 64.50	$ 61.00	n/a	n/a	
o Labour to Install Kit into Luminaires in Shop	15.00	15.00	n/a	n/a	
o New HPS Luminaires (complete)	n/a	n/a	$ 143.00	$ 143.00	
o Labour to Remove and Reinstall Luminaire on Pole	30.00	30.00	30.00	30.00	
o HP Sodium Lamp (Bulb)	20.00	20.00	incl.	incl.	
o Miscellaneous Costs	3.00	3.00	1.00	1.00	
SUBTOTAL	$ 132.50	$ 129.00	$ 174.00	$ 174.00	
o Overhead @ 17%	22.53	21.93	29.58	29.58	
TOTAL CAPITAL COST per LUMINAIRE	$ 155.03	$ 150.93	$ 203.58	$ 203.58	
Actual No. of Street Lights Involved	78	283	26	33	420
TOTAL PROJECTED CAPITAL COSTS	$12,092.34	$42,713.19	$5,293.08	$6,718.14	$66,816.75

4.2 OPERATING COSTS

The projected operating costs and the actual operating costs of the new high pressure sodium lights agree, as billed to the Town of Hay River, since their charges are based on a formula and a calculated annual amount of energy consumption (not a measured amount). The formula used by Northlands Utilities to compute the monthly utility billing for a streetlight is

TMC = MC + KWH x FCA + FF , where

TMC = Total Monthly Cost

MC = fixed Monthly Charge (independent of month of year, based on the rated energy output of the streetlight)

KWH = a calculated "system wide" average number of kilowatt hours per month of energy used by a lamp of this power rating. The number is constant for each month of the year and is apparently applied to a lamp whether located at 61°N latitude or 49°N latitude

FCA = is the Fuel Clause Adjustment factor, in $/kwh. It is a measure of the cost of the diesel fuel used to produce the electrical energy at a particular site

FF = Franchise Fee, an additional charge equal to 4.1% of MC + KWH x FCA

The monthly charge has been constant since December 1981. The FCA is revised two or three times per year.

The prevailing rates structure for Hay River is:

LAMP TYPE		MERCURY VAPOUR		HIGH PRESSURE SODIUM	
Lamp Rating	watts	400 w	250 w	150 w	100 w
Monthly Charge	$/mo.	$29.17	$20.05	$15.80	$15.00
KWH's	kwh/mo.	159	97	59	40
FCA	$/kwh	.02405	.02405	.02405	.02405
FF	$/mo.	$ 1.33	$ .92	$ .71	$ .65
TMC	$/mo.	$33.84	$23.30	$17.93	$16.61

Since 104 400W MV lamps were converted to 150W HPS lamps, and 316 250W MV lamps were converted to 100W HPS, the actual energy cost savings realized by the Town of Hay River are

104 x (33.84 - 17.93) + 316 x (23.30 - 16.61) = $3,768.68/month

or

$45,224.16 per year.

The simple economic payback of the capital invested is (66817 ÷ $45,224 per year) 17.8 months.

The annual energy saving by the 420 HPS sodium lamps can be calculated to be 340,944 KWH/year. Based on a fuel-energy conversion rate of 3.502 kwh/litre, the streetlight conversion will save 97,357 litres of generation system diesel fuel consumption per year.

Northlands Utilities expect no difference in maintenance costs or streetlamp life (24,000 hours) between the operation of a mercury vapour based street lighting system, and a high pressure sodium system.

4.3 BENEFITS

The benefits derived from the conversion program completed in Hay River are both economic and aesthetic:

a) Energy Cost Savings

The Town's energy cost has been reduced by $45,224 per year (or 34%). Their prior streetlighting energy costs were $130,586 per year.

b) Fossil Fuel Reduced Consumption

The community consumes an estimated 97,357 litres less diesel fuel per year.

c) Increase in Spare Electrical Generating Capacity

The Hay River power plant has an installed capacity of approximately 8740 kw and produced on the order of 23.6×10^6 kwh of electricity per year. The streetlight conversion provided approximately a 1.44% reduction in system utilization.

d) Improved Streetlight Service

The Town of Hay River intends to use some of the cost savings realized to add more streetlights in locations where none presently exist, or in-fill spacings between some present lamp standards to increase illumination levels above previous levels.

e) Improved Foul Weather Visibility

The orange coloured light from HPS lamps is generally regarded to yield better human visibility during snow or rain events, or during blowing snow conditions, i.e., for an equal number of lumens of light intensity many people feel they can discriminate objects better in foul conditions under HPS light, as opposed to mercury vapour light.

f) Retrofit Economics Proven

This project has proven to Alberta Power Ltd. and Northlands Utilities (NWT) Ltd. that refitting existing mercury vapour luminaires

with HP sodium lamps and ballast is a technically reasonable and economically preferable alternative to the replacement of complete luminaire assemblies.

5.0 COMMERCIAL MARKET POTENTIAL

5.1 INTRODUCTION

The conversion kits, comprised of a ballast assembly and an adapter plate, may have a significant commercial market potential. This potential may be developed by a firm or individual with a prudent strategy and the appropriate capabilities.

This section presents a discussion of the market potential for the conversion kits, and indicates a strategy that could lead to the successful commercialization of the product. The strategy is developed without a specific entrepreneur in mind. Consequently some choices remain to be made, depending on the strengths, weaknesses, capabilities, interests, and perceptions of risk by the entrepreneur.

The present technical status of this commercial product opportunity is described in earlier sections of this report. Two galvanized steel adapter plates and spacer parts have been designed to mechanically connect two commercially available Sylvania ballast assemblies to a variety of manufacturers' luminaires. The adapter plates were made by a sheet metal manufacturer using a stamping process. The opportunity for a firm or individual to build and sell this conversion kit as a product is not constrained by those involved in the Hay River conversion demonstration project. Northlands Utilities have indicated they are prepared to give the adapter plate design to any manufacturer or utility firm, and have apparently provided drawing copies to Sylvania, Lovell Lighting and others. Northlands Utilities is not in the product manufacturing field and is not interested in pursuing the potential of the conversion kit as a commercial product. Similarly the Town of Hay River and Government of the Northwest Territories are not product manufacturers, and have no interest to pursue commercialization internally. However, both the Town and the GNWT would be pleased to see a firm or individual step forward and successfully produce and sell the conversion kit product in the marketplace. The adapter plate manufacturer expressed casual interest in producing the converion kits to order, but was not inclined to promote and market the conversion kits as a product.

The present adapter plate designs are considered reasonably satisfactory by the Hay River Northlands Utilities field staff to convert the luminaires on hand in Hay River. Some room for improvement in the design was expressed, particularly if the adapters were to be promoted as "universal" adapter plates. The Sylvania supplied ballast assemblies have performed satisfactorily. Northlands Utilities (and Alberta Power Ltd. in Edmonton) have expressed confidence in a competitive conversion kit, supplied by Lovell Lighting Ltd. of Manitou, Manitoba. APL indicated they would be prepared to buy the Lovell conversion kit to meet their needs (the Lovell conversion kit approach is discussed later in this chapter).

For the purposes of this market potential discussion, the assumed objective is to describe the opportunity to produce and sell a high pressure sodium streetlamp retro-fit conversion kit to the Canadian marketplace. Two versions of the kit are implied, 400W - 150W (HPS) and 250W - 100W (HPS), and the adapter plate design is basically as developed for the Hay River application.

5.2 PRESENT MARKETPLACE CONDITIONS

Knowledge or awareness of prevailing conditions in the marketplace is a necessary prerequisite for developing a strategy to enter the marketplace. These conditions include the identification and actions of the major players, clients, and competitors, and examination of environment or exogenous factors that could influence the strategy development. These conditions are discussed in this section.

The major original equipment manufacturers (OEM's) of luminaires (complete lighting head fixtures including ballast and bulb) include Sylvania, Crouse Hinds, Power - Lite and General Electric. These major OEM's generally have manufacturing facilities in Ontario or the U.S. and have national sales organizations to call upon lamp purchasers in every region. At this point, the firms supply most of their new product sales in the form of high pressure sodium equipped fixtures in the sizes 70W, 100W, 150W, 250W and 400W. The superior efficiency of HP sodium lamps has drastically reduced the demand for new mercury vapour lamp fitted fixtures. The firms routinely supply HP sodium ballast assemblies and mounting brackets to replace mercury vapour lamps with HP sodium lamps in their own brand of luminaires. The OEM's have not actively promoted the sale of their HP sodium ballast assemblies and an adapter bracket to fit luminaires manufactured by others. One exception is that Crouse Hinds has apparently produced a ballast mounting bracket to fit some models of Sylvania and Westinghouse luminaires, as well as their own luminaires.

The ballast assemblies (and likely many other parts) in many luminaires are manufactured by a specialty manufacturer on behalf of the recognized luminaire vendor (Sylvania, Westinghouse, etc.). A specialty manufacturer may produce only wire wound cores, igniters or capacitors for a number of luminaire manufacturers, or may provide a complete ballast assembly with all components. A few firms mentioned by various utility company contacts included Sola, Allanson and Universal. Conceivably these firms could choose to enter the market to supply lamp conversion kits to fit a variety of luminaires.

The major purchasers of street lights are the utility companies. Also major cities often operate their own utility firms, or purchase "bulk" power and distribute the power within the city and own and operate the streetlights and other major electrical loads. Small cities, towns, hamlets and municipalities more frequently rely on facilities supplied and operated by the utility firms.

Random contact with lamp purchasers in Alberta, N.W.T. and Manitoba indicates a generally positive attitude to the conversion or new purchase of HP sodium lamps over mercury vapour lamps. Many purchasers are actively considering conversion programs, have pilot conversion projects in progress, or have full scale conversion programs in progress. Manitoba Hydro and Northern Canada Power Commission (NCPC) have pilot conversions in progress (10 - 50 luminaires involved). NCPC are converting 20 luminaires in Dawson, Yukon half by retro-fit, half by substitution of new high pressure sodium luminaires. Alberta Power Ltd., TransAlta Utilities Ltd., (the two largest Alberta Utilities) have conversion programs in progress (the Hay River demonstration conversion was initiated by the Alberta Power program in 1982). The City of Edmonton has committed Edmonton Power (a utility company) to the total conversion of Edmonton street lights to high pressure sodium (70W HPS mainly) in the next 3 - 5 years. The City of Calgary (a bulk power purchaser and streetlight owner) is also active in high pressure sodium conversion. The quantities of street lamps available for conversion were not systematically assembled. Some relevant figures were noted from contacts, e.g., City of Edmonton operates approximately 40,000 streetlights; Alberta Power Ltd. operates approximately 15,000 streetlights systemwide; NCPC operates approximately 3,000 streetlights systemwide; the Town of Hay River (pop. 3,400) has approximately 500 streetlights (operated by Northlands Utilities).

Indications from contacts made suggest that Alberta is most active in high pressure sodium street lamp conversions. While it is common across Canada for new lamp standards to be fitted with high pressure sodium lamps instead of mercury vapour, the degree of interest in conversions (by substitution or retrofit) of existing streetlights is apparently somewhat less developed in eastern Canada.

The present competition to a firm or individual interested in offering a retro-fit conversion kit as a commercial product was not exhaustively investigated. One competitor identified was Lovell Lighting Ltd. of Manitou, Manitoba. The firm has a good reputation for the supply of sentinel lights for farmyards, industrial yard lighting, etc. The firm is very actively promoting retro-fit conversions and appears to be very successfully capitalizing on the market interest in Alberta and western Canada. The approach followed by Lovell is to provide a popular brand of ballast assembly (Universal, etc) and supply an adapter plate specifically made for a particular model of luminaire. A broad variety of adapter plates have been apparently prepared as opposed to a single or few versions of a universal adapter plate. A client orders a ballast conversion kit for a particular model of luminaire and is supplied with the correct adapter plate and the (Lovell) chosen ballast components to do the job. Lovell is presently supplying conversion kits as part of the City of Edmonton conversion program. Lovell's sales promotion program in Canada is presently very active. Product demonstrations have been given to most of the major buyers in western Canada. Demonstration kits have been supplied in some cases. Sales to clients are increasing. Product literature has been circulated to potential buyers nationwide. The firm is presently considering the manufacture of ballast induction coils, instead of purchsing the inductors from the recognized major suppliers (Universal, etc.). This contrasts with Sylvania, etc. who choose not to build their own inductors. Lovell has a reputable technical staff held in confidence by purchasers like Alberta Power Ltd. to design and produce A.N.S.I. standard ballast assemblies.

Exogenous factors that may influence strategy development include in this case, lamp technology, energy costs, and government policy.

High pressure sodium lamp technology represents the new and preferred technology for widespread streetlighting use. It is unlikely that a more efficient technology (low pressure sodium) or manufacturing technology advances in mercury vapour lamp construction will reverse this position in the next five years (if at all).

5.6

An increase in energy costs over the years has provided the impetus to convert mercury vapour lamps to high pressure sodium lamps. Since energy costs are commonly projected to be stable or to increase, incentive to adopt HP sodium technology will remain strong.

Government actions that may strongly negatively influence demand for high pressure sodium streetlighting or negatively influence particularly a conversion kit manufacturer, remain unidentified. Government actions are likely an insignificant factor in the success of this product opportunity (discounting the adroitly applied CREDA resources, of course).

5.3 MARKETING STRATEGY

A fully developed marketing strategy should provide insight into: intended customer profile, intended product attributes, distribution methods, product price positioning, sales force attributes and actions, promotion and advertising programs, service or product support, etc. The strategy development must consider the present and likely future conditions in the marketplace, and must complement the organizational "realities" of the firm for which the strategy is developed. These realities include: existing manufacturing capabilities; sales capabilities, and product development and support capabilities; the financial strength or capabilities of the entrepreneur; the present product and sales mix of the firm; existing client base; management capabilities; etc.

In this case, the object firm or entrepreneur is not identified. Consequently the strategy outlined is requirements oriented, must stop short of an implementation plan, and may prescribe approaches incongruous with the policies or practices of particular firms.

MARKET STRATEGY ELEMENTS

a. Purpose

The purpose of this marketing strategy is to prescribe an effective program to maximize the sales volume of high pressure sodium streetlighting conversion kits in the Canadian marketplace.

b. Product Attributes

The product must exist with certain physical attributes to maximize sales volume. In this case, we do not consider this attribute set to be a variable, subject to strategic selection. Our strategy is focussed on the marketing of the conversion kit developed for use in Hay River. The intrinsic attributes include:

i. an A.N.S.I. standard ballast assembly purchased from Sylvania

ii. a single "universal" adapter plate is provided to permit installation of the ballast into a variety of luminaires (see list in Appendix C)

iii. two sizes of product are offered; a 150W HPS conversion kit, and a 100W HPS conversion kit

iv. all other intrinsic attributes are implied in the above, or are not significant such as weight, colour, speed, etc.

c. Clientele

The purchasers of the conversion kit product this strategy intends to capture are:

i. Canadian based electric utility companies

ii. Canadian municipal government adminsitrations who own and operate streetlighting equipment

iii. the Government of Canada, as owner of streetlighting equipment

No emphasis is placed on the industrial owner of lighting, the institutional owner, or the private owner.

d. Price Positioning

The pricing strategy for a conversion kit must be that the price of the kit plus the cost of conversion labour and shipping must be at least 10% less than the capital, shipping and installation labour for a new luminaire. (i.e. the minimum perceptable price difference, influencing the purchase decision is 10%)

e. Promotion and Advertising

The promotion and advertising program suitable for this product should involve two stages. This product presently faces a so-called "latent demand" market state (i.e. a substantial number of customers have a need for the product, but the product supply side of the market is not developed) and the product itself is at the early growth point in its market life cycle. Accordingly, the first stage of promotion and advertising must focus on market developmental schemes to shift demand to full demand, and to move the product to a mature state in its market life cycle. The second stage must embrace maintenance marketing concepts or remarketing concepts to prolong product life. The first stage of the promotion and advertising task is discussed here, and would perhaps apply for 12 - 18 months hence.

The suggested promotion and advertising strategy for the market development stage involves six steps:

i. client identification
ii. product literature preparation
iii. direct mail client contact
iv. telephone client contact
v. personal visitation client contact
vi. demonstration or trial equipment supply

i. Client Identification

The individuals or groups in Canada that comprise the target clientele may number less than 150. These clients should be precisely identified. This can be done in a variety of ways, including contact with provincial public utilities boards (and follow-up) to learn of the firms in the region who are power producers and municipal facilities operators, and through contact with associations of municipalities. This client base is substantially identical to the clientele of the luminaire manufacturers. Arrangements may be possible to secure their client listings.

ii. Product Literature Preparation

A professionally prepared brochure describing the product is required for a direct mail campaign. The brochure must be designed with the "latent demand" market state of this product in mind. Therefore, the intended application must be described, and the advantages of retro-fit conversion indicated. In addition, the brochure must present product attributes, provide assurance of quality, provide the assurance of stability in the vendors business, etc. The target reader will be a technically knowledgeable purchaser of streetlighting equipment.

iii. Direct Mail Client Contact

The initial contact with the target clients should be through direct mail-outs of brochures and company introductions. The numbers of customers are small, and relatively easily identi-

fied (from above). Trade magazine advertising would not likely prove cost effective as a primary contact vehicle. (It may be suitable at a later stage in product life cycle as a reinforcement aid). Step (ii) must be completed prior to step (iii), obviously. Step (i) must be at least partially completed prior to step (iii). Steps (iii), (iv), (v), and (vi) can be accomplished more or less in parallel.

iv. Telephone Client Contact

The larger clients should be contacted by telephone even prior to the direct mail-out. The product and the firm should be introduced, the initial reactions and current plans and programs of the client for streetlamp conversions should be ascertained and arrangements for follow-up made. Depending on the results of the mail-out, and early telephone contact, the total client base may or may not be contacted by telephone.

v. Personal Visitation

Personal visitations to clients should be made based on the feedback received from the earlier forms of contact (mail or phone). A sample of the product should be presented, specific attributes emphasized, and possible specific sales or demonstration opportunities ascertained.

vi. Field Trial Equipment

The entrepreneur should be prepared to offer five or ten retrofit conversion kits to clients with genuine interest to make substantial purchases. Depending on the situation, a fixed time trial with intended later removal may be agreed to, or more suitably, a "trial-with-intent-to-purchase if the product meets boasted claims" approach should be offered.

f. Sales Force

The strategy concerning the organization and deployment of the sales force is dependent on the entrepreneur's capabilities. The sales force for a firm with no other products or contact with the target

clientele should likely be a contracted sales agency or a distributor of complementary products to the target clientele. The sales agency should provide national client coverage, but does not need to be a stocking distributor.

g. Product Distribution Channels

A supply from factory type distribution plan is suitable for this form of product. One eastern and one western warehousing point may be desirable when sales volumes are large. A plan prescribing regional warehousing points or stocking distributorships is not required for this product. Supply from stock is not likely a strong requirement for this product. Supply 30 - 60 days after receipt of order will be satisfactory. Some inventory stocking of ballast components and adapter plates will likely occur anyway, to buffer against the delivery delays from conversion kit individual component suppliers.

h. Service and Product Support

The marketing strategy for this product need incorporate no unusual mechanisms for after sales support. Prudent factory quality control practices, with specific nonconformance dispositioning programs will be sufficient. The product is being sold to knowledgeable clients, and once in place, is expected to operate without incident for many years (exclusive of lamp aging and failure).

i. Product Packaging

This product does not require any emphasis to be placed on product packaging. Paper cartons each containing one complete conversion kit, suitable for shipment, and identifying the model of the kit and the vendor, are sufficient to meet this need.

j. Transportation

No unusual shipment transportation needs exist and no special or elegant transportation strategy will result in competitive advantage. (e.g. air freight next day delivery, vendor operated trucking delivery). The conversion kits would likely be sold F.O.B. factory plus shipping to customer specifications.

k. Terms of Sale

Product guarantees and warranties typical of the electrical industry would apply here. A 90 day from date of shipment limited warranty would be suitable. The limited warranty would prescribe no coverage in the event of evidence that equipment had been energized with incorrect voltages or otherwise operated in a service not intended by its design. More generous warranties would likely bring no competitive advantage or not serve to increase sales.

The cash transaction for the sale could be on a net 30 days basis from date of invoice. Deposits with order would not likely be favourably viewed by the customer. Conversely, extended credit terms for outstanding accounts would provide no competitive advantage when dealing with this target clientele.

l. Patent Protection

Legal patent advice on this product has not been secured. However, it is the author's opinion that patent protection or design registration protection does not form a viable element of marketing this product.

The only patentable aspect of this product may likely be the specific adapter plate hole patterns and design. The protection would be ineffective against a competitor with a different pattern.

KEY FACTORS FOR SUCCESS

The key factors to keep in mind through the conmercialization of this product are:

a. Product Awareness by Clients

This type of product is not widely known at this point. Both the availability of a retro-fit conversion kit, and this particular kit must be embraced in a marketing strategy.

b. Speed of Entry into Market

Success of the Hay River style retro-fit conversion kit product is dependent on moving into the marketplace quickly. Other manufacturers are active. The latent demand is shifting to real demand. This product can be expected to reach a point of sales decline (post-maturity in market life cycle) by late 1988. Market growth will be most pronounced in 1985.

c. Client Perceptions of Product Quality

The client will be most sensitive to verify that the conversion kit is electrically reliable. The ballast assembly design must demonstrably meet A.N.S.I. (American National Standards Institute) standards (the so-called A.N.S.I. trapezoid on a power vs. voltage lamp performance curve). The components must be from suppliers with quality reputations. The units must mechanically perform as intended, i.e. bolt into luminaires without field butchery to the conversion kit or the luminaire.

d. Ability to Supply

Large numbers of conversions may be attempted by a utility or a city operator in a short time span. The client must have confidence that the conversion kit vendor can deliver thousands of units per season if necessary to fit in to field crew scheduling.

RISKS OR CONSTRAINTS TO SUCCESS

a. No Barriers to Market Entry

Other firms can enter the marketplace without facing unusual barriers. The capital requirements to start-up the business are not huge, the product development investment (in time or risk to success) is small, no patent protection is likely to be particularly effective. The most significant barrier to entry is simply the success, track record, reputation and momentum of prior existing competitors.

b. OEM's could Enter the Market

The ballast manufacturers or the luminaire suppliers could decide to enter the market to supply "universal" fitting conversion kits. Their established prominence with the target clientele would make these firms formidable competitors.

c. Entrepreneur's Internal Capabilities

The weaknesses and deficiencies in the entrepreneur's organization, if not effectively identified and corrected, as they apply to this product opportunity, will represent a major source of business risk.

5.4 MANUFACTURING STRATEGY

The components of the retro-fit conversion kit include:

a. a ferrite magnetic ring, wrapped through the annulus with many turns (200+) of copper conductor, and fitted with a mounting bracket

b. a metal encased starter electrode circuit

c. a metal encased electrical capacitor

d. a sheet metal adapter plate

e. screws

f. insulated wire

g. a printed cardboard packaging carton

The manufacturing technologies for each of these componenets are well developed and suited to high volume production using specialized machinery. The entrepreneur must do a make or buy analysis for each of these components based on his existing machinery complement, skills available, the needs of other products in the firm, economic viability, perceptions of risk, etc. The cheapest per unit variable production costs are obviously achieved by the use of high volume specialized production machinery. Justification for all of this machinery based on this product opportunity was not attempted here, and is unlikely in any event.

While the actual manufacturing strategy best suited for a particular firm cannot be defined, some tendencies can be expressed. It is most likely that the conversion kit vendor (or his contractor) will be required to manually do final kit assembly and packaging, pulling together the various components, mounting components on the adapter plate, etc. Secondly, it is most likely that stamping should be the manufacturing process used to produce the adapter plates. Whether this is done in-house or by a specialized metal fabrication is indeterminant.

The cartons should be stamped and printed by a specialty manufacturer unless the kit vendor can justify the machinery investment.

The ballast assembly electrical components may be purchased from one vendor such as Sylvania, purchased individually from specialized manufacturers, or manufactured in-house. It is possible that the inductor (wire wound ferrite core) could be manufactured by the kit vendor, but is unlikely that it will be more profitable to in-house manufacture the igniter or the capacitor. Specialized core winding machinery and an A.N.S.I. compliant design are necessary to produce the inductors in-house in a profitable manner.

The exact manufacturing strategy is clearly indeterminant, and is based on the complete product slate of the entrepreneur, his inclination to seek out contract manufacturing opportunities to help pay for custom machinery, and unit costs of the components manufactured to order, using the most cost effective production techniques.

6.0 INFORMATION TRANSFER PLAN

6.1 ACTIVITIES

The experience gained by the Hay River demonstration of sodium streetlight conversion must be broadly communicated to maximize the benefits to be derived from the experience. This section presents an information transfer plan that can be executed by the project participants and the CREDA administration to accomplish this information transfer objective.

Four sets of target audiences are identified for the various aspects of the information transfer plan. These audiences are identified in Table 6.1/1.

The suggested elements of the information transfer plan are:

1. Submit copies of this report, condensations of this report or the pre-project summary, as deemed appropriate, to the various contacts suggested in target audience A. Utilities. Request the utilities to circulate the material through engineering, purchasing groups, and to field district superintendents.

2. Submit condensations of this report to the various contacts suggested in target audience B. Associations of Municipalities. Suggest the associations circulate the materials to their member communities, and to encourage the members to pursue their utility firms to initiate conversion programs.

3. Submit full copies of this report to the contacts indicated in target audience C. Trade Associations and Magazines. Suggest the magazine editorial or article writing staff include a feature on the Hay River streetlighting conversion demonstration.

4. Submit a summary of this report to the target audience D. Luminaire Manufacturers.

5. Run advertisements or bulletins in the product opportunity sections of the trade magazines listed in D. indicating the nature of the opportunity and how to get further information.

6. Request Town of Hay River representatives make an oral presentation to the next annual meetings of the N.W.T. Association of Municipalities and Association of Municipal Administrators. The presentation would outline the experiences and cost savings derived from the project.

7. Present this commercial product opportunity to the federal Department of Industry, Trade and Commerce for inclusion in their public bulletins advertising new product opportunities.

8. Initiate a search for an interested N.W.T. entrepreneur to take up this product opportunity. Present this report to Head, Commerce of GNWT Department of Economic Development. This department can offer assistance through their business contacts, filed information on capabilities, etc. to identify potentially suitable entrepreneurs; contact the potential entrepreneurs to present the product opportunity, assess their interest and capability, and to provide some assistance to get them started. If no suitable individuals are found through this process, product opportunity announcements in selected N.W.T. newspapers should be made, indicating further details are available through the GNWT (either the Energy Conservation Division, or Economic Development as appropriate).

Consideration was given to the idea of creating a display for presentation by the Town or Northlands Utilities at trade shows attended by utility industry personnel or at trade shows attended by municipal administrators. The idea was withdrawn, since the show should properly be supported by product literature and proper product support - items dealt with in the marketing strategy.

Table 6.1/1

INFORMATION TRANSFER PLAN

TARGET AUDIENCES

A. UTILITIES

All Canadian electrical energy producers and bulk municipal power purchasers including:

British Columbia Hydro
970 Burrard Street
VANCOUVER, B.C.
V6Z 1Y3

Greater Vancouver Regional District
2294 West 10th
VANCOUVER, B.C.
V6K 2H9

Canadian Utilities Ltd. (Alberta Power Ltd., Northlands Utilities Ltd., Yukon Electrical Co. Ltd.)
10035 - 105 Street
EDMONTON, Alberta
T5J 2V6

TransAlta Utilities Corporation Ltd.
(International Utilities Ltd.)
Box 1900
CALGARY, Alberta
T2P 2M1

Saskatchewan Power Corporation Ltd.
SPC Center
Victoria Avenue
REGINA, Saskatchewan

Manitoba Hydro
820 Taylor
WINNIPEG, Manitoba

Ontario Hydro
700 University Avenue
TORONTO, Ontario
M5G 1X6

Hydro Quebec
75 Dorchester West
MONTREAL, Quebec
H2Z 1A4

A. UTILITIES (Continued)

City of St. John
239 Charlotte Street
P. O. Box 850
ST. JOHN, New Brunswick
E2L 4C7

New Brunswick Power Commission
527 King Street
FREDRICTON, New Brunswick
E3B 4X1

Maine and New Brunswick Electric Power Co. Ltd.
ARROSTOOK JUNCTION, New Brunswick

Newfoundland and Labrador Hydro
Philip Place
Elizabeth Avenue
P. O. Box 9100
ST. JOHN'S, Newfoundland
A1A 2X8

Newfoundland Light and Power Co. Ltd.
Kenmount Road
P. O. Box 8910
ST. JOHN'S, Newfoundland
A1B 3P6

Nova Scotia Power Commission
P. O. Box 910
HALIFAX, N.S.
B3J 2W5

Maritime Electric Co. Ltd.
134 Kent Street
Box 1328
CHARLOTTETOWN, P.E.I.
C1A 7N2

Northern Canada Power Commission
7909 - 51 Avenue
Box 5700, Station L
EDMONTON, Alberta

Table 6.1/1 TARGET AUDIENCES

B. ASSOCIATIONS OF MUNICIPALITIES

Federation of Canadian Municipalities
1318 - 112 Kent Street
OTTAWA, Ontario
K1P 5P2

Northwest Territories Association of Municipalities
Ste 304, 4920 - 47th Street
YELLOWKNIFE, N.W.T.

Association of Municipal Administrators (NWT)
c/o Mayor
City of Yellowknife
YELLOWKNIFE, N.W.T.

Association of Yukon Communities
2131 - 2nd Avenue
WHITEHORSE, Yukon Territories

Alberta Association of Improvement Districts
Attention: Shirley Mercier
27 Lafonde Crescent
ST. ALBERT, Alberta
T8N 2N7

Alberta Association of Municipal Districts and Counties
4504 - 101 Street
EDMONTON, Alberta
T6E 5G9

Alberta Urban Municipalities Association
8712 - 105 Street
EDMONTON, Alberta
T6E 5V9
Executive Director - T. Buchenen

Union of British Columbia Municipalities
Ste. 204 - 604 Blackford STreet
NEW WESTMINSTER, B.C.

Saskatchewan Association of Rural Municipalities
2075 Hamilton Street
REGINA, Saskatchewan
S4P 2E1

Saskatchewan Urban Municipality Association
1819 Cornwall Street
REGINA, Saskatchewan
S4P 2K4

B. ASSOCIATIONS OF MUNICIPALITIES (Continued)

Union of Manitoba Municipalities
P. O. Box 397
PORTAGE LA PRAIRIE, Manitoba
R1N 3B7

Manitoba Association of Urban Municipalities
201 - 377 Henderson Hiway
WINNIPEG, Manitoba

Rural Ontario Municipalities Association
902 - 100 University Avenue
TORONTO, Ontario
M5J 1V6

Association of Municipalities of Ontario
Ste. 902 - 100 University Avenue
TORONTO, Ontario
M5J 1V6

Union of Municipalities of Quebec
922 est Rue Liege
MONTREAL, Quebec
H2P 1L1

Union of Nova Scotia Municipalities
Ste 132 - 136 Roy Building
1657 Barrington Street
HALIFAX, Nova Scotia
B3J 2A1

Federation of P.E.I. Municipalities
Box 98
City Hall
CHARLOTTETOWN, P.E.I.

Table 6.1/1 TARGET AUDIENCES

C. TRADE ASSOCIATIONS AND MAGAZINES

Canadian Electrical Association
Ste 580, One West Mount Square
MONTREAL, P.Q.
H3Z 2P9 R & D Department, and Manufacturers Association

Transmission and Distribution Magazine
ISSN 0041 - 1280
c/o Cleworth Publishing Co.
One River Road
COSCOB, Conn. U.S.A.
06807

Electrical World Magazine
c/o McGraw-Hill Inc.
1221 Avenue of Americas
NEW YORK, New York
10020

Power Magazine
McGraw Hill, Inc.
1221 Avenue of Americas
NEW YORK, New York
10020

Power Engineering
Dun-Donnelley Publishing Co.
BARRINGTON, Illinois, U.S.A.

Canadian Electrical Engineering Journal
Ste. 700, 2050 Mansfield Street
MONTREAL, P.Q.
H3A 1Z2

Illuminating Engineering Society of North America
345 East 47th Street
NEW YORK, N.Y. 10017

*good reference
Electrical Blue Book
Kerrwil Publications Ltd.
20 Holly Street, Suite 201
TORONTO, Ontario
M4S 2E6

Table 6.0/1

D. LUMINAIRE MANUFACTURERS

Various luminaire and ballast assembly manufacturers, including:

GTE Sylvania Lights Products Group
8750 Cote Deliesse Road
MONTREAL, Quebec
H4T 1H3

Westinghouse
1910 Barton Street East
HAMILTON, Ontario

Crouse Hinds Canada Ltd.
1160 Birchmount Road
SCARBOROUGH, Ontario
M1P 2B9

Power Lite Devices Ltd.
54 Atomic Avenue
TORONTO, Ontario
M8Z 5L4

Universal Manufacturing Corporation (ballast)
200 Robin Road
P. O. Box 3028
PATTERSON, N.J. 07509

Allanson Manufacturing Co. Ltd. (ballast)
33 Cranfield Road
TORONTO, Ontario
M4B 3H2

Appleton Electric Ltd. (ballast)
750 Lawrence Street
CAMBRIDGE, Ontario
N3H 2N1

Sola Canada Ltd. (ballast)
377 Evans Avenue
TORONTO, Ontario
M8Z 1K8

Sola Basic Ltd.
125 East Dr.
BRAMALEA, Ontario
L6T 1B8

D. LUMINAIRE MANUFACTURERS (Continued)

GTE Sylvania Canada Ltd.
35 Vulcan Street
REXDALE, Ontario
M9W 1L3
(416) 247 - 6171

Canadian General Electric Lamp Division
940 Landsdowne Avenue
TORONTO, Ontario
M6H 3Z4

McGraw Edison Ltd. Power Systems Division
3595 St. Clair Avenue E.
SCARBOROUGH, Ontario
M1K 1M1

Phillips Electronics Ltd. Lighting Division
601 Milner Avenue
SCARBOROUGH, Ontario
M1B 1M8

Federal Pioneer Ltd.
19 Waterman Avenue
TORONTO, Ontario
M4B 1Y2

Ferranti - Packard Transformers Ltd.
121 Industry
Toronto, Ontario
M6M 4M3

6.2 COST ESTIMATE

The costs to implement the information transfer plan are estimated as follows:

Step		
#1	o report duplication and mailing costs assume 20 copies @ $10.00	$200.00
	o administration cost - 8 hrs @ $25.00	200.00
#2	o report duplication and mailing costs assume 15 copies @ $6.00	90.00
	o administration cost - 16 hrs @ $25.00	400.00
#3	o report duplication and mailing costs assume 10 copies @ $10.00	100.00
	o administration cost - 8 hrs @ $25.00	200.00
#4	o report duplication and mailing costs assume 10 copies @ $6.00	60.00
	o administration cost - 4 hrs @ $25.00	100.00
#5	o bulletin writing administration - 1 hour @ $40.00	40.00
	o placement administration - 8 hrs @ $25.00	200.00
#6	o	nil
	TOTAL	$1,590.00

7.0 CONCLUSIONS AND RECOMMENDATIONS

The major conclusions resulting from the Hay River sodium street light conversion demonstration are summarized here, together with recommendations.

CONCLUSIONS

1. The conversion of existing streetlighting from mercury vapour to high pressure sodium is cost effective.

2. Retro-fit conversion of existing mercury vapour street lamps to HP sodium is technically viable and economically more cost effective than whole luminaire substitution type conversions.

3. A "universal" style adapter plate can be satisfactorily used to mount one size of ballast assembly into a variety of manufacturers luminaires.

RECOMMENDATIONS

1. Retro-fit high pressure sodium street lamp conversions should be performed on all mercury vapour lamp equipped luminaires.

2. The commercial product opportunity for a universal adapter plate style of ballast conversion kit should be exploited.

3. The information transfer plan should be executed.

APPENDIX A

Energy, Mines and Resources Canada | Energie, Mines et Ressources Canada

Northwest Territories **Public Works**

Street Lighting Conversion

Pre-Project Summary

Canada/Northwest Territories Conservation and Renewable Energy Demonstration Program

Project Location:
Hay River, N.W.T.

Date:
December 7, 1983

Technology:
Conservation, Electricity

Project Manager:
Councillor Steve Brooks,
Town of Hay River,
Box 1306,
Hay River, N.W.T. X0E 0R0

Project No:
H3.3.26/83-7022

Sector:
Public - Street Lights

Status:
Monitoring

Province:
Northwest Territories

Purpose:
To demonstrate the effectiveness of "converting" mercury vapour (MV) street lights to high pressure sodium lights (HPS).

Description:
To convert the existing 250w and 400w mercury lights to 100w and 150w high pressure sodium units of equivalent illumination. In some cases retrofitting was not possible, in which event new lights were installed. These new lights will serve as a control in determining the added maintenance costs associated with the converted units as opposed to the new units.

Contributors:

Canada/N.W.T. CREDDA	-material and equipment	$13,000
	-compiling and monitoring information	2,000
	-provision for Tech Transfer	5,000
Town of Hay River		47,988
Total		$67,998

Expected Benefits/Savings:
On the conversion of the 400w (MV) to 150w (HPS) units the savings will be approximately $192/unit/year, while the 250w (MV) to 100w (HPS) conversions will be approximately $79.20/unit/year. With 106 x 400w (MV) and 308 x 250w (MV) lamps being changed the total savings to the town is expected to be $44,080/year. In terms of kilowatts, the savings will be 337,872 kw/year. Based on the efficiency of electrical generation in Hay River (3.502 kw/litre diesel), the annual savings in fuel will be 96,479 litres. Benefit from this project lies mainly in the incentive it will provide for other communities to do the same conversion.

Further Information:
As further experience is gained with the units, information will be supplied on the details of the project, the costs, the problems, suppliers of the materials, and the methods of installation.

Information Contact:

Councillor Steve Brooks,
Town of Hay River,
Box 1306,
Hay River, N.W.T. X0E 0R0
(403) 874-6522

or

Energy Conservation Division,
Department of Public Works,
Government of the Northwest Territories,
Yellowknife, N.W.T. X1A 2L9
(403) 873-7203

Project Name:
Street Lighting Conversion

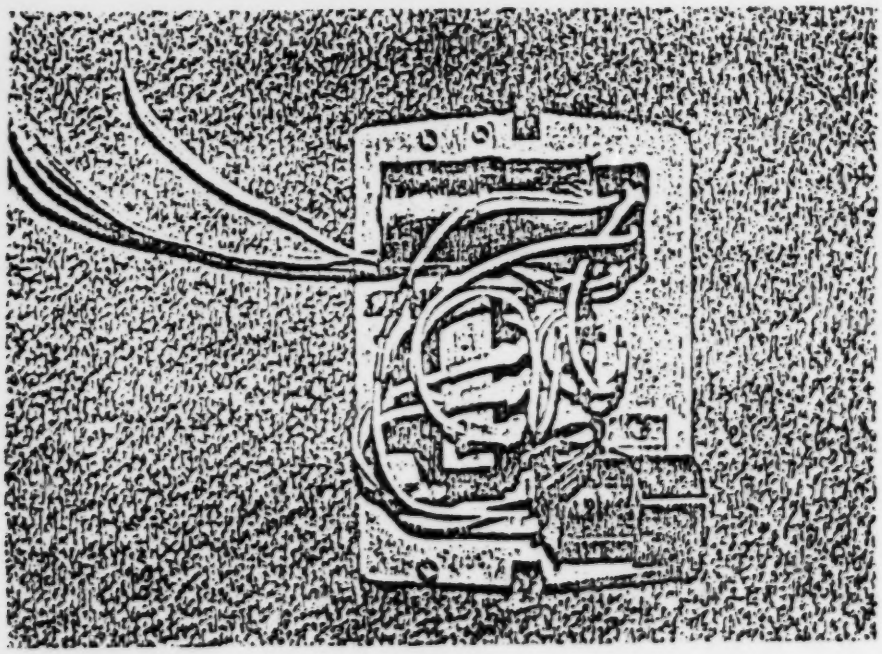
Economic Analysis:
Project Costs - Ballast Conversion Kits

100w and 150w HPS	$19,935
New units	7,237
Bulbs	8,280
Replacement lamps	1,730
Conversion kits	7,833
Labour	17,973
Information Tech Transfer	5,000
Total	$67,988
Payback Period	1.5 Years

Monitoring/Evaluation:
Serving of the installations and provision of operational data will be provided in the Technical Information Transfer report.

Technical Details/Specifications:
A suitable ballast on a universal type mounting plate was produced and tested on site by Northland Utilities (NWT) Ltd. of Hay River. This mounting plate can be fixed to any streetlight currently in use in the Northwest Territories.

Photograph:



High Pressure Sodium Ballast Conversion Kit

APPENDIX B

PHOTOGRAPHS

PROJECT SIGN

Placed on the east side of Hwy #5 at the entrance to the Town of Hay River

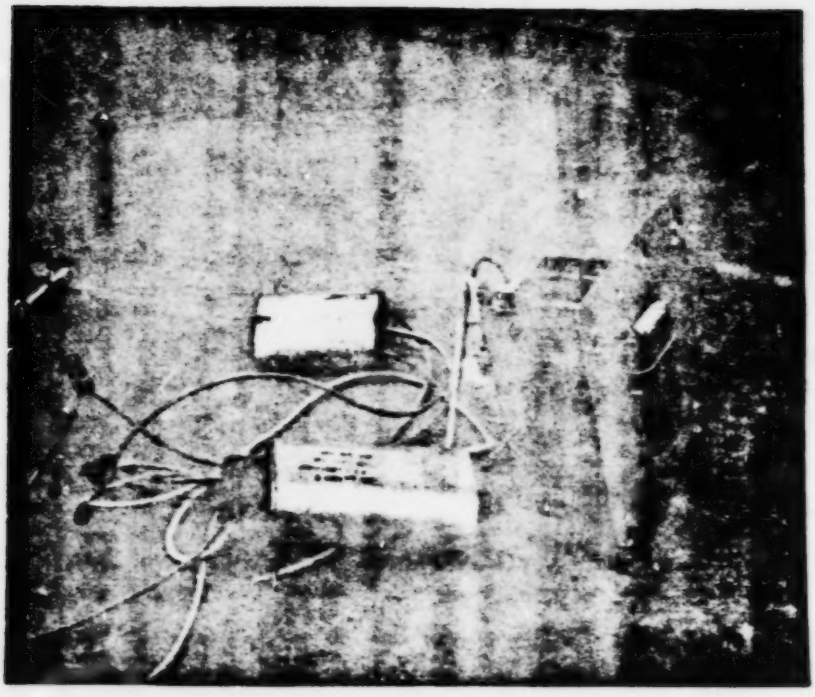
SYLVANIA 100W HP SODIUM BALLAST ASSEMBLY

- o capacitor on Top, igniter unit, wound ferrite core on bottom, all mounted by manufacturer on a galvanized steel carrier plate

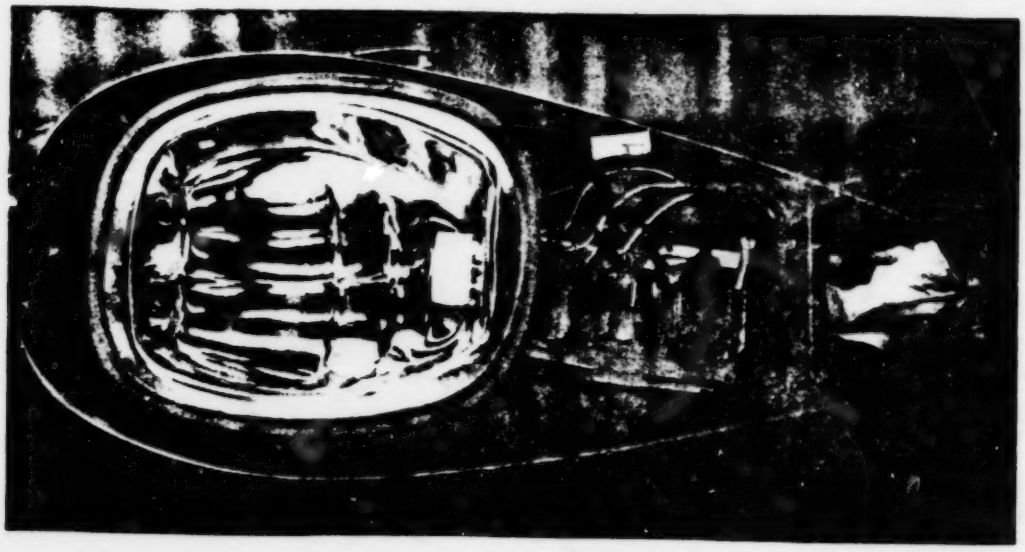
HAY RIVER ADAPTER PLATE

- o a 1/16" galvanized stamped plate to interface Sylvania 100W HPS ballast carrier plate to a variety of luminaires

SYLVANIA 150W HP SODIUM BALLAST AND HAY RIVER ADAPTER PLATE



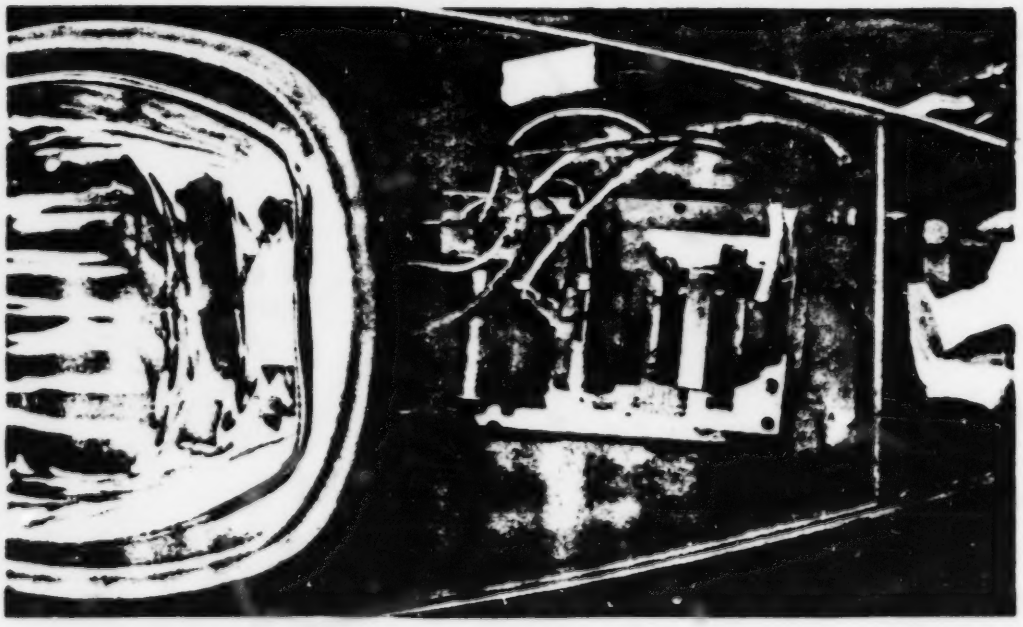
- o igniter can, center top
- o capacitor can, center bottom
- o wound ferrite coil fitted with Hay River 150W adapter plate

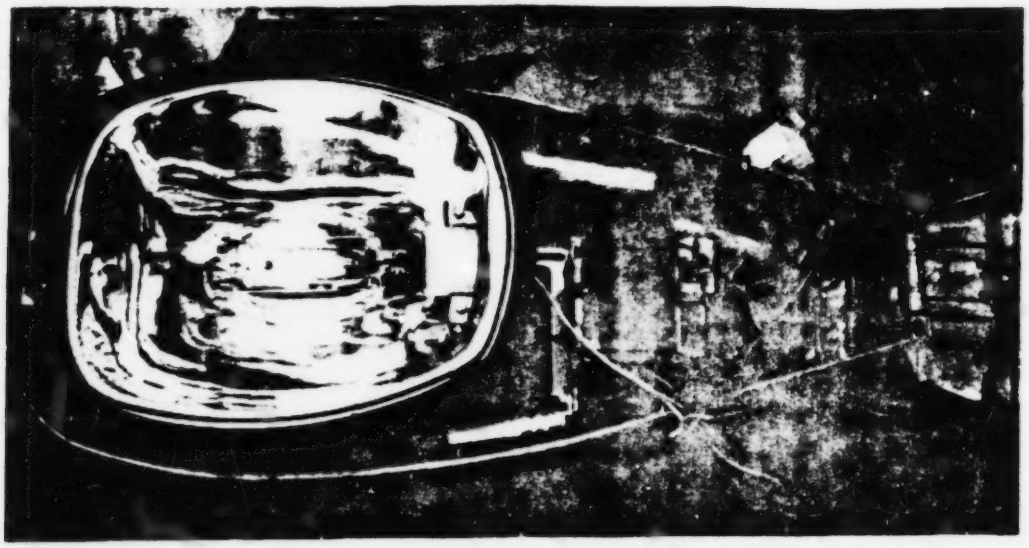


250W MERCURY VAPOUR LUMINAIRE (Bottom half of body and Glass Cover removed) REFITTED WITH 100W SYLVANIA HIGH PRESSURE SODIUM BALLAST ASSEMBLY

CLOSE UP

Note the adapter plate underneath the light sheet metal carrier supplied with the wound core, starter and capacitor

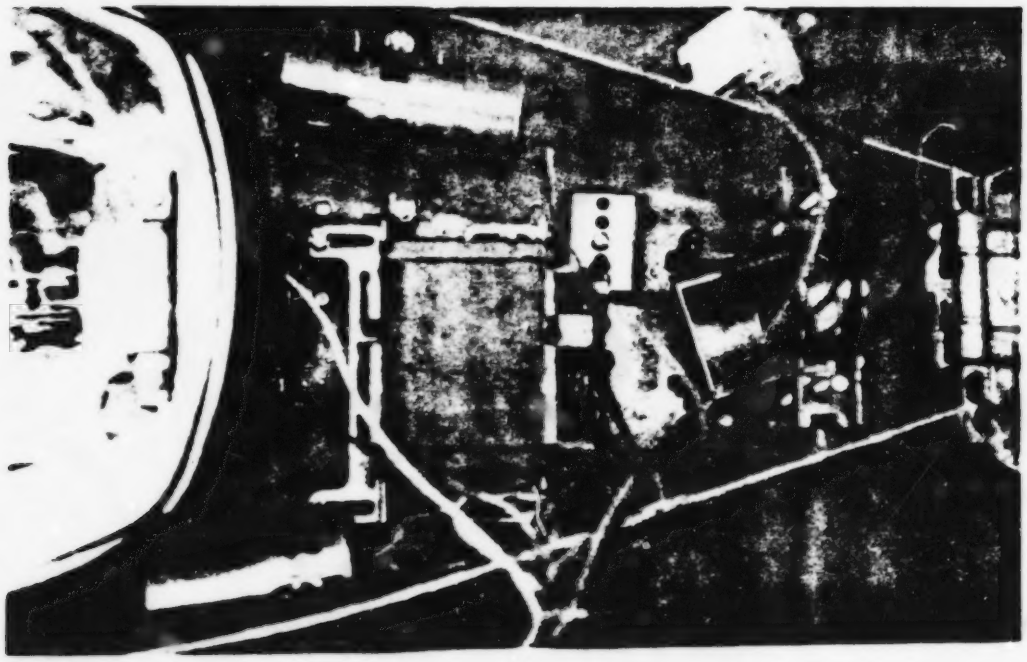




SYLVANIA 400W MERCURY VAPOUR LUMINAIRE (Bottom half of body and Glass Cover removed) REFITTED WITH 150W SYLVANIA HIGH PRESSURE SODIUM BALLAST KIT

CLOSE UP

Note that no adapter plate is required here as Sylvania supplied ballast brackets fit into Sylvania luminaires



HIGH PRESSURE SODIUM LIGHT TESTER

- Tester screws into fixture in place of HPS bulb to verify correct wiring of the luminaire, operation of ballast and availability of power

APPENDIX C

ADAPTER PLATE

FABRICATION DRAWINGS & NOTES

- Adapter Plate

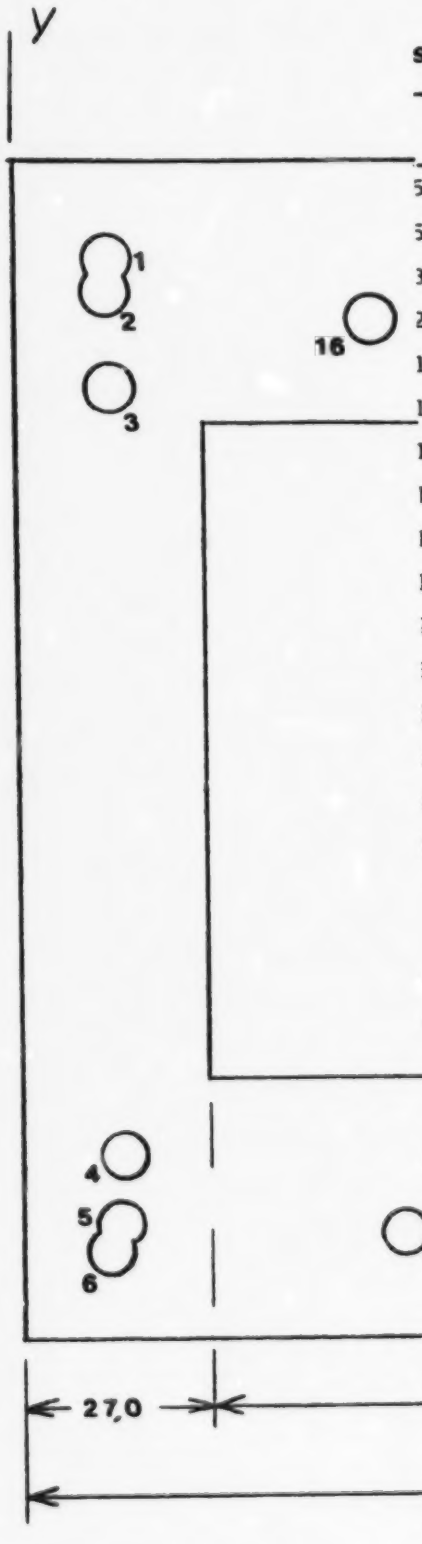
  400W Mercury Vapour

  to 150W HP Sodium

- Adapter Plate

  250W Mercury Vapour

  to 100W HP Sodium



s of Hole Locations (mm)

Y	#	X	Y
56.5 mm			
52.5			
38.5			
25.5			
17.2			
13.0			
15.0			
17.0			
13.0			
17.2			
28.0			
38.5			
52.5			
56.5			
18.0			
18.0			

anized steel plate
iameter (1/4")
accurate to ± 0.3 mm
millimeters (mm)

- 150W (HPS)
PLATE

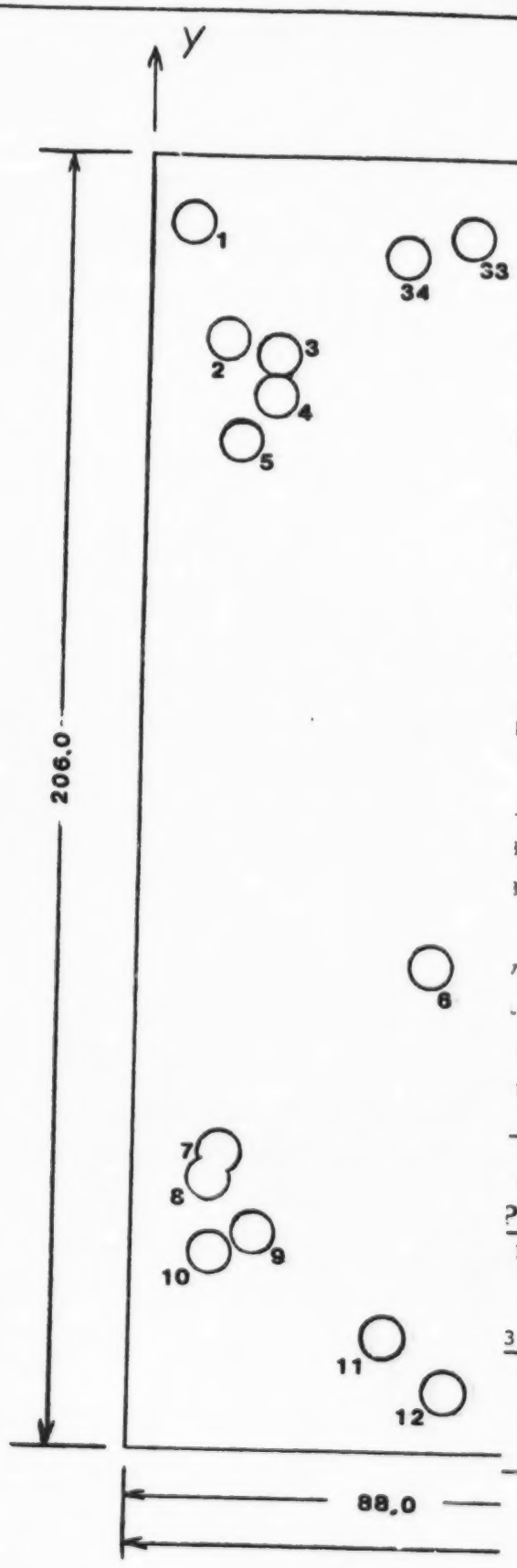
DRAWING #

REVISION

3 4 5 6 7

Mar. 1/84
DATE

≈ 1:1
SCALE



of Hole Locations (mm)

Y	#	X	Y
5.0 mm	18	121.0 mm	31.0 mm
6.5	19	d e l e t e d	
4.0	20	121.0	47.5
7.0	21	119.0	65.0
0.5	22	d e l e t e d	
7.0	23	121.0	160.00
8.0	24	114.5	166.5
13.0	25	110.0	171.5
14.5	26	114.0	173.0
31.0	27	120.5	176.0
.8.0	28	93.0	167.5
9.5	29	64.0	166.0
14.0	30	99.0	194.0
8.5	31	94.0	190.0
.8.0	32	84.5	193.0
39.5	33	50.0	193.0
35.0	34	39.5	189.5

vanized steel plate
ameter (1/4")
accurate to ± 0.3 mm
millimeters (mm)

- 100W (HPS)
PLATE

DRAWING #

REVISION

3 4 5 6 7

DATE Mar 1/84

SCALE ≈1:1

100W HPS ADAPTER PLATE FITTINGS

	Light Type	Use Hole #:
#1	McGraw or CLM	1, 10, 16, 18, 27 plus 4 x 1" spacers
#2	GE, Cat. #5773066	11, 15, 31, 34
#3	Power Lite, Cat #132217, and McGraw Cat. #LUDM251220G	3, 9, 17, 25
#4	McGraw	2, 12, 14, 32, 33
#5	Westinghouse	5, 7, 20, 23
#6	Westinghouse	4, 8, 16, 24
#7	Westinghouse, Cat. #0414B	13, 29 plus 2 x ¼" spacers

150W HPS ADAPTER PLATE FITTINGS

	Light Type	Use Hole #:
#1	McGraw, Cat. #LUDM4012206	1, 6, 9, 14
#2	Power Lite, Cat. #1322555	7, 8, 15, 16 plus 4 x 1¼" spacers
#3	Westinghouse	2, 5, 10, 13
#4	Ballast holes for 150W HPS	3, 4, 11, 12

ISDW 1485

ADAPTER PLATE FITTINGS

LIGHT TYPE

#1 M'GRAW ---- use holes #1, 6, 9, 14

#2 use holes #3, 8, 15, 16

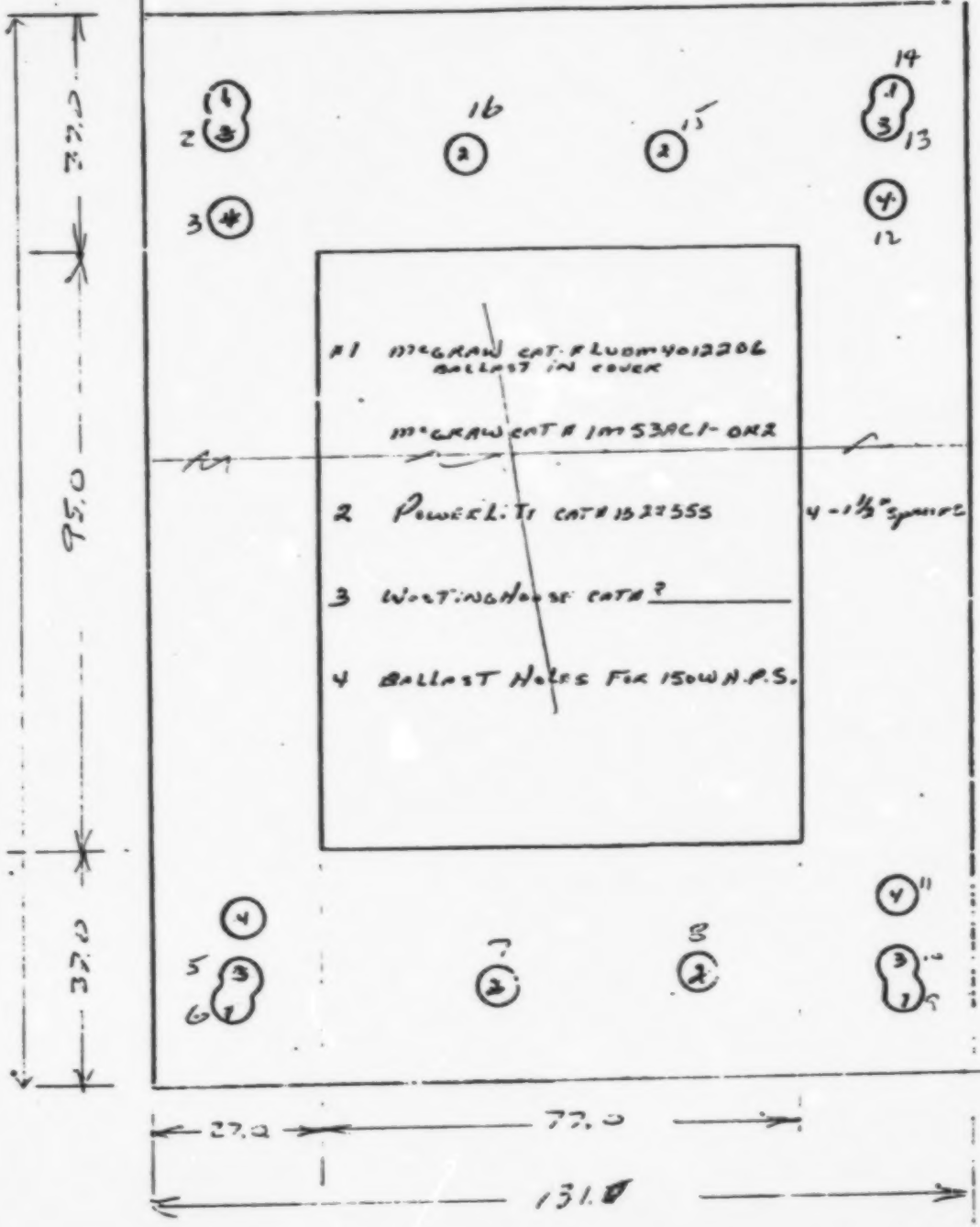
#3 use holes #2, 5, 10, 13

#4 use holes #3, 4, 11, 12

ALBERTA POWER LIMITED
CALCULATIONS SKETCHES

SHEET 1 of 1
DATE Sept-16-2
JOB NO.
BY CHKD.

# BASE PLATE FOR 400W ST LITE CONVERSION
400W(MV) TO 150W(HPS)
ADAPTER PLATE



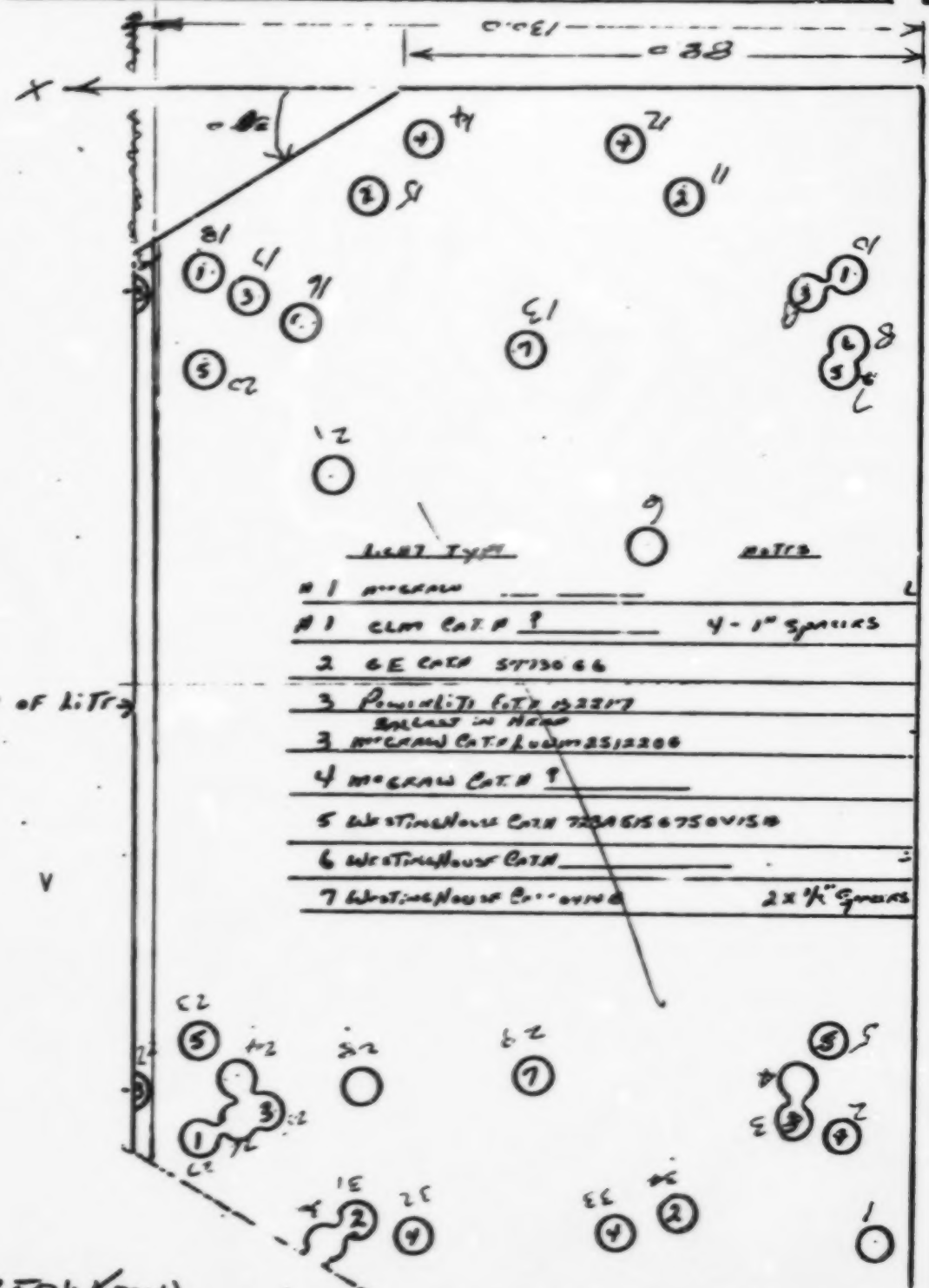
100W HPS
BOARDER LATE LIGHTS

	LIGHT TYPE	USED HOLES
#1	McGRAW or CLM	#1, 10, 16, 18, 27 plus 4 - 1" spacers
#2	GE CAT # 5TD066	11, 15, 31, 34
#3	POWER LITE CAT # B12.7 AND McGRAW CAT # LUOM25122DG	3, 9, 17, 25
#4	McGRAWS	2, 12, 14, 33, 37
#5	[illegible]	5, 7, 20, 23
#6	[illegible]	4, 8, 16, 24
#7	[illegible] CAT # 6414B	13, 29 plus 2 x ½" spacers

ALBERTA POWER LIMITED
CALCULATIONS SKETCHES

SHEET Nov 4
DATE 82-10-2
JOB NO.
BY CHKD

BASE PLATE FOR 250W ST LITE CONVERSION



250W(MV)
TO 100W(HPS)
ADAPTER PLATE

70